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Supplement No. 1
Final Report on Acceptance Testing Phase One of NASA Nickel-Cadmium Battery Test Project

Contract No. NAS 5-3027
ER 13219

Martin Marietta Corporation
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1.0 Introduction

This paper is a supplement to Engineering Report No. ER-13179, Final Report on Acceptance Testing, published under NASA contract No. NAS 5-3027, (October, 1963).

This report presents acceptance test data, acquired after publication of the previously mentioned report, on 13 pressure transducer equipped cells received from the manufacturer on 15 October 1963. Also included in this report is a battery breakdown list, by cell, of the 12 batteries to be used in performance of the phase two, cycling test, portion of the battery test project.

2.0 Test Results

2.1 Phenolphthalein Leak Test

No leaks were found in any of the cells tested.

2.2 Capacity Test

2.2.1 Capacity. Capacity values are listed in Table 1 below. The average capacity of the 13 cells was 6.00 ampere hours with a standard deviation of 0.28 ampere hours.

TABLE 1

Mfg's Serial No.	Test Cell No.	Ampere-Hour Capacity
4785	F240S	6.022
4778	241	5.808
4812	242G	6.000
4807	243	5.633
4790	244	6.402
4813	245	6.087
4780	246	6.140
4787	247	6.175
4768	248	5.567
4770	249	6.485
4784	250	5.751
4789	251	6.161
4796	252	5.790

Legend

Prefix

F - Failed Cell

Suffix

S - Shorted Cell
G - Blocked Gauge

2. 2. 2 Terminal Voltages. Terminal Charging voltages are listed in Table 2. The average terminal voltages for charges 1, 2 and 3 are as follows.

Charge No. 1 ---------- 1. 456 volts
Charge No. 2 ---------- 1. 438 volts
Charge No. 3 ---------- 1. 433 volts

TABLE 2

Test Cell No.	F240S	241	242G	243	244	245	246	247	248	249	250	251	252
Chg. 1	147	146	147	145	145	144	144	145	145	149	145	146	145
Chg. 2	145	143	146	142	144	142	142	144	142	149	143	145	143
Chg. 3	144	143	146	142	143	141	141	144	142	147	142	145	143

2. 2. 3 Pressure. Terminal Pressure readings are listed in Table 3. Readings labeled CHG. 1 TERM, CHG. 2 TERM and CHG. 3 TERM represent cell pressures recorded at the termination of capacity test charges No. 1, No. 2 and No. 3, respectively. All negative readings are in Inches of Mercury and all positive readings are in Pounds Per Square Inch. Pressure Readings on cell 242 indicated a blocked gauge.

TABLE 3

Cell No.										
F240S	241	242	243	244	245	246	247	248	249	Time
+05	+10	+00	+25	+20	+00	+00	+11	+20	+05	CHG 1 TERM
+05	+35	+00	+35	+33	+08	+07	+11	+40	+20	CHG 2 TERM
+00	+05	+00	+15	+05	-05	-15	+05	+10	+05	11-1
+00	+07	+00	+17	+07	-04	-14	+05	+12	+05	11-2
+00	+09	+00	+19	+09	-03	-13	+06	+14	+06	11-3
+01	+11	+00	+21	+11	-02	-11	+06	+17	+06	11-4
+01	+12	+00	+22	+12	-01	-10	+07	+20	+07	12-1
+02	+14	+00	+24	+14	+00	-09	+07	+22	+07	12-2
+02	+15	+00	+26	+16	+00	-07	+08	+24	+08	12-3
+03	+16	+00	+28	+17	+01	-05	+08	+26	+08	12-4
+04	+18	+00	+30	+18	+01	-04	+09	+28	+09	13-1
+04	+20	+00	+31	+19	+02	-03	+09	+29	+09	13-2
+05	+21	+00	+32	+20	+03	-02	+10	+30	+10	13-3
+05	+23	+00	+34	+22	+03	-01	+10	+32	+11	13-4
+05	+25	+00	+36	+24	+04	+00	+10	+34	+12	14-1
+06	+27	+00	+38	+25	+04	+01	+11	+35	+13	14-2
+06	+29	+00	+40	+26	+05	+02	+11	+37	+14	14-3
+06	+31	+00	+41	+27	+06	+03	+11	+38	+15	14-4
+06	+34	+00	+43	+30	+07	+04	+11	+40	+17	15-1
+06	+37	+00	+46	+32	+07	+04	+12	+42	+20	15-2
+06	+39	+00	+48	+34	+09	+05	+12	+44	+22	15-3
+07	+40	+00	+48	+35	+10	+05	+12	+45	+23	15-4
+06	+42	+00	+49	+35	+10	+11	+12	+45	+24	16-1
+06	+42	+00	+49	+35	+10	+11	+12	+46	+24	16-2
+06	+43	+00	+50	+35	+10	+11	+11	+46	+24	16-3
+06	+43	+00	+50	+35	+10	+11	+10	+48	+24	CHG. 3 TERM

TABLE 3 (CONTINUED)

250	251	252	
+15	+24	+24	CHG. 1 TERM
+24	+29	+37	CHG. 2 TERM
+28	+32	+40	CHG. 3 TERM

Pressure readings on these 13 cells as they were received from the manufacturer are listed in Table 4:

TABLE 4

Cell No.	Pressure	Cell No.	Pressure
240	-10	247	+01
241	-18	248	-11
242	+00	249	-12
243	-01	250	-18
244	-05	251	+00
245	-11	252	+01
246	-23		

2.3 Cell Short Test

Cell number 240 was rejected because of an internal short circuit. All cells are listed below with their open circuit voltage after the specified 24 hour stand period.

TABLE 5

Test Cell No.	Cell Voltage (Volts)
240	0.013
241	1.124
242	1.155
243	1.155
244	1.152
245	1.156
246	1.153
247	1.125
248	1.142
249	1.152
250	1.236
251	1.200
252	1.191

2.4 Internal Resistance

The internal resistance for each cell is listed in Table 6.

TABLE 6

Cell No.	Milliohm Int. Res.	Cell No.	Milliohms Int. Res.
240	3.9	247	4.0
241	4.2	248	3.9
242	3.5	249	4.2
243	3.7	250	3.7
244	3.7	251	3.9
245	3.5	252	3.9
246	4.4		

3.0 Battery Selection

Computer techniques were used to assign all accepted cells to the various batteries required for the cycling tests. The 12 batteries were selected in a manner that resulted in each battery having an average capacity and standard deviation as close as possible to the average capacity and standard deviation of all accepted cells. These Batteries are listed in Table 7.

TABLE 7

Battery No. "O" Avg. Capacity = 6.228 A.H. Std. Deviation = .205 AH									
Cell No. 210	091	208	041	064	049	059	089	213	252
A.H. Cap. 6.004	6.130	6.515	6.187	6.209	6.266	6.418	6.397	6.366	5.790
Battery No. "1" Avg. Capacity = 6.339 A.H. Std. Deviation = .229 AH									
Cell No. 100	060	088	218	027	227	063	019	017	241
A.H. Cap. 6.672	6.117	6.519	6.480	6.453	6.445	6.279	6.296	6.322	5.808
Battery No. "2" Avg. Capacity = 6.332 Std. Deviation = .147 AH									
Cell No. 244	029	229	009	193	003	068	198	034	031
A.H. Cap. 6.401	6.052	6.549	6.178	6.506	6.213	6.432	6.269	6.384	6.327
Battery No. 3 Avg. Capacity = 6.153 Std. Deviation = .193 A.H									
Cell No. 243	102	075	108	021	011	054	231	005	096
A.H. Cap. 5.633	6.056	6.104	6.148	6.209	6.218	6.248	6.278	6.301	6.331
Battery No. 4 Avg. Capacity = 6.338 Std. Deviation = .147 AH									
Cell No. 251	023	052	092	020	093	007	046	228	072
A.H. Cap. 6.161	6.589	6.549	6.174	6.497	6.231	6.248	6.279	6.309	6.331
Battery No. 5 Avg. Capacity = 6.177 Std. Deviation = .234 AH									
Cell No. 248	032	002	042	214	073	006	030	095	206
A.H. Cap. 5.567	6.056	6.104	6.148	6.475	6.235	6.253	6.279	6.314	6.340

TABLE 7 (CONTINUED)

Battery No. 6	Avg. Capacity = 6.375			Std. Deviation = .146					
Cell No.	247	078	016	070	111	109	200	053	195	216
A. H. Cap.	6.174	6.602	6.580	6.174	6.488	6.239	6.423	6.410	6.318	6.349
Battery No. 7	Avg. Capacity = 6.234			Std. Deviation = .215					
Cell No.	044	120	004	071	211	037	047	110	244	250
A. H. Cap.	6.030	6.558	6.170	6.182	6.235	6.257	6.418	6.392	6.353	5.751
Battery No. 8	Avg. Capacity - 6.352			Std. Deviation = .151					
Cell No.	246	018	205	197	086	097	057	094	225	010
A. H. Cap.	6.140	6.606	6.143	6.152	6.475	6.462	6.423	6.405	6.375	6.344
Battery No. 9	Avg. Capacity = 6.329			Std. Deviation .164					
Cell No.	245	217	056	036	015	067	024	090	099	079
A. H. Cap.	6.087	6.646	6.143	6.152	6.480	6.248	6.418	6.401	6.370	6.349
Battery No. 10	Avg. Capacity - 6.339			Std. Deviation = .155					
Cell No.	249	209	215	212	105	221	085	028	107	040
A. H. Cap.	6.484	6.065	6.100	6.506	6.183	6.471	6.436	6.414	6.392	6.327
Battery No. 11	Avg. Capacity = 6.356			Std. Deviation = .186					
Cell No.	230	066	106	033	026	062	103	065	014	242
A. H. Cap.	6.654	6.113	6.523	6.484	6.453	6.440	6.274	6.301	6.322	6.000